# Design Approval

## I-5, Northbound On-Ramp at Bakerview Rd - Improvements
**MP 257.65 – MP 258.50**

XL5465 PIN 100591R

October 2018

**WASHINGTON STATE DEPARTMENT OF TRANSPORTATION**
Northwest Region - Mount Baker Area
Bellingham, Washington

**Gabe Ng, PE**
Project Engineer


**Design Approval:**

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Oct 24 2018 3:05 PM
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Date: _____

**Washington State Department of Transportation**

## Project Description

The project is located on Interstate 5 (I-5) between MP 257.65 and MP 258.50 within the City of Bellingham in Whatcom County. The project vicinity map is included in Appendix A.

This project will construct a second northbound on-ramp on the east side of the I-5 / Bakerview Road Interchange and revise the channelization. The existing northbound on-ramp on the west side of the interchange will remain for those heading northbound approaching from the west, and the new on-ramp will originate at the existing northbound off-ramp terminal. The new ramp will merge with the existing northbound on-ramp prior to making a single point connection to the I-5 mainline, and will provide northbound access to I-5 for vehicle trips originating from the east side of the interchange. The channelization revision of Bakerview Road will increase the capacity of the roadway across the bridge and improve signalized ramp terminal operations.

The project will impact wetlands and wetland buffers, requiring wetland mitigation in addition to roadside restoration. Major drainage impacts are expected and will require retrofitting the system and adding to the system based on the new impervious. Illumination, ITS & traffic signal work will be included.

Project Definition A00591R: I-5 / Northbound On-Ramp at Bakerview - Improvements was approved on August 23, 2017 and has been included in the Project Summary Documents. See Appendix B.

| Route I-5 | NHS Status | Access Control | ADT (2016) | Truck % | Posted Speed | Functional Classification | Terrain |
|---|---|---|---|---|---|---|---|
| MP 257.65-258.50 | NHS Principal | Limited Access – Full Control | 45,000 – 59,000 | 6 % | 60 MPH | U5 – Urban Interstate | Rolling |

This project has a scheduled advertisement date of October 7, 2019. Construction is expected to begin Spring of 2020 and be completed in Fall of 2020.

## Cost Estimate / Funding

Project A00591R is funded through the ***Connecting Washington*** (CWA) program under the sub-program I1 - Mobility / Urban Mobility. The budget allocated for this project as shown in the Transportation Executive Information System (TEIS) is summarized in the table below:

| WIN A00591R | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PIN** | **Sub Program** | **Fund Type** | **Biennium** | **PE** | **CN** | **RW** | **Total** |
| 100591R | I1 | CWA | 17-19 | $1,126,200 | $0 | $2,349,100 | $3,475,300 |
| 100591R | I1 | CWA | 19-21 | $373,800 | $6,150,900 | $0 | $6,524,700 |
| **Totals by Phase:** | | | | **$1,500,000** | **$6,150,900** | **$2,349,100** | |
| | | | | | | **Project Total:** | **$10,000,000** |

The Engineer's Estimate for construction at the 10% design level is $6,084,364 and has a medium confidence level. The construction estimate is based on scoping level quantities, field observations, 70% survey completion and a 10% design level surface model. A higher level of confidence will be achieved once the new roadway has been fully modeled in CADD and compared to the existing surface. The Basis of Estimate and Engineer's Estimate are included in Appendix C.

The NWR Real Estate Services (RES) group estimate for Right-of-Way acquisitions is $3.3M. This includes approximately $950,000 in condemnation risk. Current allocation for Right-of-Way is $2.35M. This cost discrepancy is being managed by the Project Office and may be addressed with funding reallocation from contingency funds and/or supplemented from project partners.

## Basis of Design

The Basis of Design (BOD) documentation for this project was approved by the Assistant State Design Engineer on July 3, 2018. It documents a discussion of how the design was determined, the project baseline and contextual needs, the design parameters used, as well as a comparison of alternatives developed in the Interchange Justification Report (IJR). The BOD is included in Appendix D.

## Design Elements

An Interchange Justification Report (IJR) was prepared for this location to address the engineering and operational feasibility of adding the proposed new on-ramp. The IJR lays out the interchange planning process, the evaluation of improvement alternatives, the proposed improvement, the impacts to the interstate and local street system, and the coordination details with adopted local and regional plans that support and justify the request for an access revision. The IJR was prepared in accordance with the Washington State Department of Transportation's (WSDOT) Design Manual Chapter 550, (M 22-01.11 July 2014) and Federal Highways (FHWA) regulations. The IJR has been included in Appendix E.

## Design Decisions / Justifications

The design follows the guidelines in the Design Manual (July 2017). No Design Analyses are required for this project to date.

1. **Bakerview Road Channelization revision** – One of the recommendations included in the IJR is a re-channelization of Bakerview Road through the interchange to accommodate an expected increase in demand for the west-east movement and reduction in the demand in the east-west movement. Changes will include adding a right-turn drop lane and revising the lane configuration on the existing overpass. See the Traffic section below.

   The lane width for the additional left turn lane at the I-5 Southbound Off-Ramp / Bakerview Road intersection was maximized to 12.5 feet in width to provide as much buffer width as possible to WB-67 trucks that will navigating the turn on to eastbound Bakerview Road. The other lane widths at this location were reduced to 11 feet. This is consistent with DM 1231.

   Left and right turn channelization radii that will be modified at intersections along Bakerview Road are based on a P passenger design vehicle, and all movements were evaluated with turn simulation software to ensure that WB-67 vehicles will be accommodated.

A severe lane misalignment between eastbound approaching and receiving lanes at the I-5 Southbound Ramps / Bakerview Road intersection was created as a result of the revised channelization. The design will resolve this issue by including a 21:1 lane shift beginning on the east side of the intersection. This rate is acceptable for the design speed of the roadway according to DM 1310.02(3).

The existing I-5 Southbound On and Off-Ramp turn pocket lengths were reduced in order to accommodate the additional through lane on Bakerview Road. There is no data suggesting that a queueing issue exists at these locations, and the change in length will not impact existing intersection Level of Service. All other turn pocket storage lengths were preserved or increased to improve capacity, in coordination with the Traffic office.

Additional yield line pavement markings were added to the I-5 Southbound On-Ramp to reinforce the existing yield sign. This will help alert drivers and yield the right-of-way to westbound vehicles entering the ramp from the north.

The design of the intersection of the new northbound on-ramp and Bakerview Road will restrict access to the connection, and only allow westbound traffic to enter the ramp via the right-turn drop lane. A traditional through lane and “pork chop” traffic island with a right-turn slip lane, as shown in the final IJR draft design proposal, will not be included in the design. However, the IJR draft proposal includes a note specifying that alternatives to the right-turn slip lane will be analyzed, due to concerns from the City of Bellingham regarding pedestrian safety.

Benefits to eliminating this through lane include:

- **Improved pedestrian safety** – Reduces the number of vehicle-pedestrian conflict points to a single location on the drop lane. Pedestrians will only be required to look for vehicles from a single direction in a single stream. Entering vehicles will not be required to look for vehicles entering the stream from other directions, allowing for increased focus on the pedestrian crossing. Additionally, Rectangular Rapid Flashing Beacons (RRFBs) may be installed to increase visibility of the crossing.
- **Improved vehicle safety** – Removes multiple vehicle-vehicle conflict points associated with merging, through, and left-turn movements within the intersection
- **Improved mobility** – The existing signal will not require an additional signal phase for pedestrian movements, and will increase the operational capacity of the signal.
- **No change to existing conditions** – Currently, northbound vehicles wishing to re-enter I-5 from Bakerview Rd are required to proceed to the west side of the interchange and use the existing on-ramp. This will still be permitted as a result of this design.
- **Reduced environmental impacts** – since the project footprint is reduced, impacts to wetlands and wetland buffers, as well as stormwater runoff will be reduces.
- **Reduced construction costs** – construction costs will be reduced as a result of fewer materials, working days, erosion control, stormwater treatment, utility relocations, and traffic control.

The City of Bellingham has reviewed the approved channelization plan, and has accepted the proposed design. See the Local Agency Coordination section below for more information.

2. **Cut and Fill Slopes** - In order to maintain safety requirements, while reducing the project footprint and minimizing impacts to wetlands and adjacent structures, this project will request to install 4:1 fill slopes along the new on-ramp, with a short section of 3:1 fill near the toe of the ramp to avoid right-of-way impacts.

3. **Horizontal and Vertical Alignment** - In order to minimize the congestion impacts of multiple on-ramps, the IJR had determined that Bakerview is to maintain one single access point on I-5. To accommodate this, the two NB on-ramps merge first before merging onto I-5. This will be accomplished by maintaining a 4' wide painted separator between the new NB on-ramp to ensure that the two ramps merge before joining I-5.

   The primary vertical constraint of the project is the existing NB flyover ramp. Because of limited right of way, the vertical alignment of the new ramp is forced to go underneath the flyover. This requires vehicles to descend the ramp at a 5% downslope with an 8% superelevation in order to match in with existing pavement by the time they reach the existing bridge.

   Horizontal curve radii, length and superelevation were designed using design speeds that are based on estimated vehicle speeds according to Design Manual chapter 22-01.12. Horizontal curve radii vary from 300 to 800 feet, with superelevations ranging from 2 to 8 percent. Vertical curves have been designed according to these same calculated design speeds, with curve lengths ranging from 30 to 400 feet. These roadway geometrics accomplish the project goals while maintaining adequate stopping sight distance, and further Design Analyses are not expected.

   The ramp design proposed in the IJR recommends using a 14 foot ramp width for the entirety of the ramp, and merge lengths corresponding to a 50:1 taper rate. However, after analyzing the survey data obtained during the design phase, it was determined that the merge between the new and existing on-ramps must occur further north than anticipated to account for elevation differences on the existing ramp. As a result, the new on-ramp width will narrow from 14 feet at the Bakerview Road intersection to 12 feet as it transitions to the soft barrier separated segment along I-5 mainline. The soft barrier will be 4 feet in width in order to reduce the total roadway width and allow for additional adjustment of the beginning of the merge. These changes in cross section widths are within the acceptable guidance found in DM 1360.03(4), and allows for the reduction of Right-of-Way requirements, maintains clear zone for adjacent roadways, prevents re-alignment of the existing ramp and bridge abutment, and reduces the overall project footprint.

   The merge between the new and existing on-ramps has no specific guidance in either the Design Manual or Standard Plans, and only a length recommendation in the IJR. It was assumed that the merge functions as a Collector-Distributer (C-D) merge, and was designed according to DM Exhibit 1360-15c with a 780 foot merge length. This merge length satisfies both the IJR recommendations and the minimum length required by the Design Manual for C-D merges.

An additional 600 foot ramp segment was included between the C-D merge and the I-5 on-connection per recommendation in the IJR. The segment will incorporate a 150:1 taper to terminate the soft barrier.

The final on-connection was designed as a single-lane parallel on connection with a 12 foot ramp width. The parallel-type connection was designed according to DM Exhibit 1360-13b and the Standard Plans, and will provide additional traffic calming length prior to the final merge onto I-5 mainline.

## Environmental

Sensitive areas have been identified within the project vicinity. Wetlands were delineated and surveyed in June 2018. The project will work to minimize impacts to these wetlands and wetland buffers.

The Environmental Classification Summary (ECS) was approved on September 10, 2018 documenting the SEPA Determination of Non-significance (DNS) and Checklist. The ECS has been included in Appendix F.

## Traffic

The project will revise the channelization on Bakerview Road Bridge through the I-5 interchange in the City of Bellingham.

With the addition of a northbound on-ramp on the east side of the interchange, there will be a significant decrease in the number of vehicles crossing the overpass. Additionally, with the construction of a Costco on the east side of the interchange, there is a predicted increase in demand for the southbound I-5 to eastbound Bakerview Rd movement. Because of these factors, the overpass will be re-channelized to provide more capacity for the eastbound movement.

Proposed channelization revisions include the conversion of an existing westbound through-lane into a right-turn drop lane onto the new on-ramp, changing the existing configuration of the Bakerview Road Bridge from 2 westbound/1 eastbound lane to 1 westbound/2 eastbound lanes, and the movement and modification of existing islands and sidewalks to accommodate these changes.

The Channelization Plan titled *I-5 NORTHBOUND ON-RAMP AT BAKERVIEW RD* was approved on 9/17/2018 and has been included in Appendix G.

## Traffic Studies and Analysis

During the course of the IJR, multiple traffic studies were conducted to analyze the impacts of the design alternatives with regard to safety, mobility, and multimodal compatibility. These studies include the following.

- *Traffic Analysis (2016)* – Compared Level of Service (LOS) in the 2020 year of opening and 2040 design year for the No-Build and Proposed Alternative. The results show improved LOS at the I-5/Bakerview Rd interchange, with no adverse effects at adjacent intersections and interchanges.

- *Safety Analysis (2015)* – Analyzed the safety performance of the No-Build, R-B (proposed), R-C and R-R alternatives. The results show a decrease in crashes over No-Build for all alternatives.

- *City of Bellingham Technical Memorandums* – This includes a series of technical memorandums prepared by the City of Bellingham, including:
    - Analysis of non-motorized transportation connections, needs, and plans
    - Recommendation for future forecast of vehicle traffic at the Bakerview/I-5 interchange
    - Inability to provide adequate bikeways east and west of the Bakerview/I-5 interchange

  These memorandums concluded that the cost of including additional infrastructure to accommodate non-motorized transportation outweighs the potential connectivity benefits, and similar results could be achieved by focusing on lower cost alternatives within the vicinity.

- *CityScape Traffic Analysis* – This memorandum was conducted by Transportation Solutions Inc. on behalf of the City of Bellingham to analyze includes a series of technical memorandums prepared by the City of Bellingham, including:

## Right of Way / Access Control

This project requires total acquisitions from 2 parcels in order to construct the project. NWR Real Estate Services (RES) completed appraisals for the acquisitions and subsequent offers to the property owners in April 2018. The existing Limited Access boundary will be revised to include the new on-ramp as part of the acquisition process.

A Right of Way Plan revision to Sheet 6 of 17 of SR 5 MP 256.53 TO MP 262.43 BELLINGHAM TO SMITH ROAD VICINITY was approved on December 8, 2017. This revision added Parcels 1-24648 and 1-24649, added the proposed on-ramp alignment, noted grade intersection, deleted topography in the vicinity of LM 30+00 RT, revised the Limited Access boundary lines, added a new detail for the eastern corner of parcel 1-24648, and added ownership verification note. Sheet 6 is included in Appendix H.

Right of way purchases from Madrona Bay Real Estate Investments LLC (1-24648) and Silver Lake Holdings Inc. (1-24649) are required to accommodate the widening along Bakerview Road, the construction of the new on-ramp and installation of stormwater runoff treatment and flow control facilities.

Significant impacts and change of use is proposed for both of the above properties, and full parcel acquisitions are expected. Coordination with the property owners is in progress. The Right of Way acquisitions for this project are a high risk at this time due to high initial appraisals and current use disputes with the property owners.

## Materials

Initial piezometer locations were determined during a site visit with NWR Materials on January 30, 2018 in order to begin collecting groundwater measurements in the event that either a retention pond or infiltration is selected as the preferred flow control BMP for the project. Piezometer installation and soil test borings were conducted in March, 2018, and the NWR Materials office is continuing to provide piezometer data to the Project Office.

## Construction / Maintenance Coordination

The design team has worked closely with the construction and maintenance offices to address all constructability concerns as well as develop the staging plans. The construction office has historically been an active participant during the design phase, and will continue to work with the design office throughout the project.

## Local Agency Coordination

The project team has done ongoing coordination with the City of Bellingham during the IJR and scoping phases of this project. As stated previously, the City provided a series of technical memorandums to evaluate the feasibility of including non-motorized improvements as part of the project scope. The City concluded that any non-motorized accommodation would require either a reduction in vehicle capacity, or widening the existing overpass.

The Project Office compared an alternative that included reduced capacity over the bridge, but determined that the resulting detrimental impacts to LOS through the interchange were not justified by the predicted non-motorized connectivity. Likewise, the cost associated with widening the existing bridge was not justified based on the predicted connectivity benefits, and similar benefits could be achieved through enhancements at nearby locations for a significantly lower cost.

The design includes a non-signalized right-turn drop lane for westbound traffic entering the on-ramp, and does not include a northbound through lane. As stated in the *City of Bellingham Technical Memorandums*, the City will not support improvement options that compromise pedestrian safety for the benefit of vehicle operations, such as a slip-lane offering a “free right-turn” to a new northbound on-ramp. As a result, the design team has included a configuration that requires right-turning vehicles in the drop lane to stop at the signalized intersection prior to entering the on-ramp. The intersection includes marked pedestrian crossings and ADA compliant curb ramps where applicable. The City has reviewed the channelization plan and concurs with the design, and agrees that adequate safety for pedestrians has been provided and is in agreement with city policy point TC-6.

The Project Office will continue this coordination during the design phase to ensure the city is allowed the opportunity to review and comment on the design prior to advertisement.

## Public Engagement / Community Involvement

Public stakeholders for the project were identified and outreach was included as part of the IJR process. The Tier 1 and Tier 2 alternatives were presented to both the City of Bellingham Transportation Commission on October 11, 2016 and Tier 2 alternatives were presented at a public open house meeting on October 25, 2016. Comments and input from these meetings were documented in the IJR and incorporated into the selection of the preferred alternative.

# APPENDICES

**Vicinity Map** *Appendix A*

**Project Summary Documents** *Appendix B*
- A00591R Project Definition
- ERS Standard Report

**Cost Estimate and Funding** *Appendix C*
- Basis of Estimate
- Engineer's Estimate

**Basis of Design** *Appendix D*
- Basis of Design
- Alternatives Comparison Table
- Design Parameters Worksheet

**Interchange Justification Report** *Appendix E*
- Interchange Justification Report Document
- Safety Analysis

**Environmental Classification Summary** *Appendix F*

**Approved Channelization Plan** *Appendix G*

**Approved Right of Way Plans** *Appendix H*

**Alignment Plan and Profiles** *Appendix I*
- Alignment/Right of Way
- Roadway Profiles